former experiment, it be passed through a screen with a hole in it (either square or a long slit at right angles to the electric displacement), the position of interference, as might be anticipated, was not shifted out as much as before. In the rough experiment made, it was found to occur at about 19 centimetres from the screen.

It was now thought well to repeat the determination of the index of refraction with a larger wall and metallic reflector than had been used before, as this change of phase might have affected the former results. But it was found that it had not done so to a sensible extent. However, the result of these new experiments was finally to give for paraffin, μ = 1·75, and at the same time it was found that the wave-length given by the "vibrator" was 68 and not 66 centimetres, as had been assumed.

Two new knobs for the "vibrator" had been made, and the fact had been overlooked that they were slightly larger than the old ones, which gave a wave-length of 66 centimetres. These new knobs were electro-plated with gold, and were a great saving of trouble, as they could be cleaned by merely rubbing with paper; apparently, the gold which was carried across by the sparking in the form of a black powder coming off, but some may have reburnished on. It was a curious thing that, if the knobs were left uncleaned over-night, the next morning it was very hard to get the black off, some molecular change probably occurring.

If the value of μ thus found be not in some way due to the paraffin being in separate blocks, it would show a remarkable anomalous dispersion for paraffin near these curiously slow vibrations, and, as suggested by Prof. Fitzgerald, may be connected with the vibration periods of atoms in the molecule, as it can hardly be connected with the vibrations in the atoms themselves. It might be interesting to investigate whether these slow vibrations could cause dissociation, and thus lead to a photographic method of observing them. It may also be allied with ordinary electrolysis by very long period currents, as is also suggested by Prof. Fitzgerald.

Assuming μ=1·75,[1] and λ=68 centimetres, the thicknesses of the walls in the "Newton's ring" experiment, as above described, were wrong. However, it was found more convenient to alter the angle of incidence to suit the walls than to change the thickness of the walls. Thus, the mirrors were put at 25°, which is the proper angle with the above data for 10 centimetre and 20 centimetre walls. On now repeating the experiment, better results were obtained than I should have anticipated. When the wall was 10 centimetres thick, continuous sparking was easily obtained, but, when 20 centimetres thick, it was only after much adjustment and patience that perhaps one slight spark could be obtained. This was quite sufficient, considering the nature of the wall, for it was only built up of plates, which afforded internal reflections, weakening the transmitted rays, and also since it requires the sum of the effects arising from the multiple reflections back and forward inside the wall to completely interfere with the front, and some of these are lost at the edge of the beam.

FRED. T. TROUTON.

ICE GROWTH.[2]

SEVERAL of the Arctic Expeditions have instituted observations on the rate of growth of the ice during the winter, and in the "Contributions to Arctic Meteorology," vol. i., 1885, records of this nature are given for the following stations: Gulf of Boothia, Assistance Bay, Port Bowen, Walker Bay, Cambridge Bay, Camden Bay, Princess Royal Islands, and Mercy Bay. The second German Arctic Expedition has also undertaken such investigations and published results in its report (Leipzig, 1874).

In the present paper these observations are compared with the results of the theory of ice-formation, the basis of which has been explained by the author in a paper on some points in the theory of the conduction of heat.

The theory gives for the thickness (λ) of ice formed in the time (t) the following formula, which is approximately correct—

$$\lambda^2\left(1 + \frac{cb}{3\lambda}\right) = \frac{2kT}{\lambda\sigma}.$$

In this formula (c) is the specific and (λ) the latent heat of ice; (k) is the coefficient of conduction, (σ) is specific gravity, (f) is the temperature at the surface of the ice at the time (t), (k) the sum of cold for the same time; the last is the sum of the temperatures counted downwards from 0° C., from the commencement of ice formation up to the time (t).

The squares of the measured ice-thicknesses were taken and multiplied by the factor contained in the above formula, and the differences between the successive values were divided by the sums of cold for the corresponding intervals of time. The quotients for the different observations of each station differ in some degree from each other. Those which are most regular are the Gulf of Boothia, Assistance Bay, Port Bowen, and the German Expedition. The mean values for these four stations are, respectively, 0·877, 0·851, 0·869, and 0·878. Of the stations which show considerable differences, Walker Bay gives 0·919, Cambridge Bay 0·780, Camden Bay 0·791. The smallest quotients are, 0·755 for Princess Royal Islands, and 0·700 for Mercy Bay in the first winter, whilst it is 0·810 for the second winter.

We may take 0·87 as the normal value of the quotient. If any station gives considerably less than this, it may be concluded that some disturbance of the process of ice formation has occurred, such as, *e.g.*, if the station was affected by a warm current which brought up warmer water, and so delayed the formation of the ice.

The units for the figure 0·87 are the Fahrenheit degree, the English inch, and the day. For Celsius, centimetres, and the day, the figure would be 10·092. From it the coefficient of conduction of Polar ice, k, is 362·4. If the second be taken as the unit of time, the value of k would be 0·0042.

DR. C. FORSYTH MAJOR'S DISCOVERIES IN THE ISLE OF SAMOS.

WE are glad to learn that Dr. H. Woodward, who has just returned from Florence, has secured for the Palæontological Department of the British Museum (Natural History) the valuable collection of Vertebrate remains of Lower Pliocene age obtained by Dr. C. Forsyth Major during the year 1887 in the island of Samos, in the Turkish Archipelago. Dr. Forsyth Major lately contributed to the *Comptes rendus* (vol. cvii. pp. 1178–81) a preliminary notice of this collection. Among the remains are a large number of forms specifically identical with the mammals from the equivalent deposits of Pikermi in Attica, Baltavar in Hungary, and Maragha in Persia; but there are also some new types, which are of interest either from a distributional or a purely zoological point of view. Among these new forms is a species of ant-bear (*Orycteropus*), which is the only representative of that genus yet known beyond the Ethiopian region. A large pangolin, which is estimated to have been nearly three times the size of the West African *Manis gigantea*, is made the type of the new genus *Palæomanis*; and is of interest as showing how the African pangolins may have been connected with those of India. Perhaps the most striking new

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[1] This value agrees with polarization experiments. No reflection was obtained at its corresponding angle, while at $\tan^{-1}$ 1·51 some sparks were occasionally seen.

[2] Abstract of Dr. Stefan's paper, "Ueber die Theorie der Eisbildung, insbesondere über die Eisbildung im Pola-Meere," from the *Sitzungsberichte* of the Vienna Academy.

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type is a large ruminant, referred by the author to the *Giraffidæ*, and stated to connect *Helladotherium* and the giraffe with some of the aberrant antelopes of Pikermi. Finally, a large ostrich is especially noteworthy from a distributional point of view, since we now have remains of this genus from Samos, the Thracian Chersonese, and Northern India.

NOTES.

WE regret to have to record the death of the eminent American physicist, Prof. Elias Loomis. He was born at Wellington, Connecticut, in 1811, and was educated at Yale College, where he acted for some time as tutor. He was successively Professor of Mathematics and Natural Philosophy in Western Reserve College, Ohio; Professor of Natural Philosophy in the University of the City of New York; and Professor of Natural Philosophy and Astronomy in Yale College. The latter appointment he received in 1860, and he held it until his death. Prof. Loomis was the author of more than 100 scientific treatises. Among his works was a series of text-books on mathematics, natural philosophy, astronomy, and meteorology. Of this series more than 500,000 copies were sold. During the last twenty-five years of his life he devoted himself chiefly to original research, and gave much time and energy to the preparation of a full account of the principles of meteorology. He was a member of various American and European scientific Societies.

ON August 19 the fiftieth anniversary of the foundation of the Observatory at Pulkowa was celebrated. Among those present on the occasion were the President of the St. Petersburg Academy of Science, the Grand Duke Constantine Constantinovitch, the Russian Ministers and Court dignitaries, the German and French Ambassadors at the Russian Court, and deputations from the Universities and Academies of Russia, and from foreign observatories, including Greenwich and the chief German observatories. Numerous congratulatory telegrams were received. The Czar expressed in a telegram high appreciation of the scientific merits of the Observatory.

THIS week the meeting of the Photographic Convention of the United Kingdom is being held in London. It was opened on Monday in St. James's Hall, where an interesting collection of photographic appliances and specimens of the best photographic work had been brought together. In his inaugural address, Mr. Andrew Pringle, the President, reminded his hearers that the present year was the fiftieth of practical photography, and traced the history of the art from its birth to its jubilee.

AT the meeting of the Linnean Society of New South Wales on June 26, Dr. Oscar Katz read a paper giving an account of experimental researches with the microbes of chicken-cholera. In this paper the author describes the investigations undertaken by him since last year with regard to the microbes of chicken-cholera. The larger portion of the experiments were made on wild rabbits; in addition, the action of the microbes on domestic poultry, as well as on indigenous birds, on hares, guinea-pigs, and ferrets was studied. A number of other points in the life-history of the chicken-cholera bacteria are dealt with in the paper: for instance, their behaviour when transmitted through the bodies of rabbits in successive generations; towards desiccation, putrefaction, &c. Rabbits were repeatedly protected against a virulent infection, in consequence of having previously partaken, at intervals, of cultures of the microbes in which the latter had been killed by moderate heat.

ON August 17, at 1 o'clock a.m., a severe earthquake shock of an undulatory character, lasting six seconds, was felt at Jablanica, Bosnia. The direction of the seismic wave was from south-east to north-west. According to a telegram from Mostar, a shock, lasting ten seconds, was felt there also on August 17. Some damage was caused to the railway line between Mostar and Ostrojac, while at Konjica a wall collapsed. The duration of the shock at the latter town was only five seconds.

THE Pilot Chart of the North Atlantic Ocean for the month of August shows that fine weather prevailed generally over the greater part of the North Atlantic during July. The only storms worthy of notice were two which prevailed in the western part of that ocean; the first was situated in latitude 40° N., longitude 58° W., on the 10th, and moved across Newfoundland on the 16th; the next day it was joined by the second storm, which passed out to sea from the coast of New Jersey on the 15th. The storm then travelled about north-north-east, and disappeared off the south coast of Greenland. Much fog has been experienced along the Transatlantic routes, and icebergs have been numerous, within the usual limits.

THE Report of the Meteorological Commission of the Cape of Good Hope for the year 1888 contains monthly summaries and results for 38 stations and rainfall statistics at 292 stations, including returns from Basutoland, Orange Free State, &c. In addition to the tables, there are some extremely interesting diagrams showing the actual rainfall in 1888 at a number of stations throughout the colony, as compared with the average rainfall. They show that in nearly all months the fall in 1888 was much above the average. Storm warnings are not yet issued, but weather telegrams are received from a number of stations, and after correction and collation, reports are sent to coast stations and entered on charts, for the information of seamen and others.

VOLS. IX. AND X. of *Aus dem Archiv der Deutschen Seewarte* contain reports of the activity of that institution during the years 1886 and 1887. The collection of observations at sea, and at distant stations, has been carried on with vigour, while weather telegraphy and the verification of chronometers and nautical instruments also receive great attention. Dr. Neumayer regrets that the ever-increasing routine work curtails the time for scientific investigation, yet the volumes contain many valuable researches by members of the staff, to some of which we can only very briefly refer, although all are worthy of careful study. In vol. ix. Dr. van Bebber, dealing with typical weather-conditions, investigates the passage of barometric depressions over Europe during the years 1881–85, in continuation of a former paper referring to 1876–80. The object of the discussion is to trace the influence of the depressions upon the weather, with a view to the discovery of the laws of the changes of direction of their tracks, and of their rates of progression. The author shows that the depressions move along certain tracks with greater velocity than the motion of minima generally. The text is illustrated by twenty plates. The other articles are: on the determination of the refraction constants; and remarks from ships' logs relating to weather, &c., in Eastern Asiatic waters. In vol. x. Dr. Köppen contributes a useful paper on the determination of air-temperature. The author investigates the influence of radiation on different thermometers and screens, and gives a *résumé* of the experiments with regard to the latter in various countries, and of the observations on local differences of temperature (including the influence of radiation). These experiments seem to show that screens through which the air can freely pass are better than large shelters, and that the effect of radiation is lessened by the free circulation of the air, and by the smallness of the thermometer-bulbs. M. Möller contributes an article on the circulation of the atmosphere between the equator and the Poles. The results arrived at differ from those of Prof. Ferrel, especially with regard to the

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